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0445-B

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3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

SOUTHAMPTON INNOVATIONS LIMITED
University of Southampton
Highfield
Southampton SO17 1BJ

Patents ADP number *(if you know it)*

07438740001

If the applicant is a corporate body, give the country/state of its incorporation

United Kingdom

4. Title of the invention

PEST CONTROL

5. Name of your agent *(if you have one)*

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

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Barn West
Dixies
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9951003

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Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

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PEST CONTROL

DESCRIPTION

This invention relates to the control of pests, such as, insect pests, and is especially, but not exclusively, related to the control of flying or crawling insect pests.

The constant pressure of pesticide use in agriculture can lead to the development of pesticide-resistance amongst insect pest species, resulting in the killing of non-target animals including beneficial predators and parasites which tend to maintain a natural balance of the pest species. Also, it leads to the contamination of the environment with consequential harmful effects on human and animal health, resulting from exposure to pesticide residues in water and comestible products. Therefore, it is desirable to target pest species accurately and to minimise the amount of pesticide which finds its way into the environment and/or on to non-target animals and organisms.

In International Patent Application No. PCT/GB93/01442 (Publication No. WO94/00980), there is disclosed means for targeting accurately pest species, such disclosure including a method of luring one sex of an inspect pest species to a bait using that insect pests' sexual pheromone, usually in the form of a volatile attractant, contaminating that insect pest with electrostatically-charged powder or other particulate material formulated with a suitable slow-acting killing agent or behaviour-modifying chemical and allowing the so-contaminated insect pest to

contaminate other insect pests of the opposite sex during mating attempts. For this method to operate, it is desirable that as much as possible of the powder or other particulate material is picked up by the target insect pest and not lost into the environment by the action of wind and weather, where it can affect non-target animals or organisms.

Accordingly, it is an object of the present invention to provide various methods of and means for controlling pests, such as flying or crawling insect pests, which overcome, or at least substantially reduce, the disadvantages associated with the known pest control methods discussed above.

One aspect of the invention provides a method of controlling a pest by at least partially coating the pest with a particulate material, such as a powder, incorporating a killing or behaviour-modifying agent, which method comprises directing, attracting or otherwise luring the pest on to or above a surface bearing such a particulate material which is rendered airborne by the movement of the pest on, above or in the region of the particulate material-bearing surface.

A second aspect of the invention resides in pest control apparatus comprising a surface on to, above or in the region of which a pest is capable of being directed, attracted or otherwise lured and which bears a particulate material, such as a powder, incorporating a killing or behaviour-modifying agent, wherein the particulate material is capable of being rendered airborne by movement of the pest, on above or in the region of the particulate material-bearing

surface.

The particulate material is preferably a powder which is sufficiently fine for it to be rendered airborne by a pest moving across, flying above or taking-off from the particulate material-bearing surface, so that the pest, such as an insect pest, becomes at least partially coated with the powder which may comprise or be combined with at least one biological, synthetic or natural pesticide as a killing agent.

Preferably also, the particulate material, such as a powder, may have properties which enable it to become charged electrostatically, for example by friction, as it is rendered airborne from the particulate material-bearing surface.

One preferred inventive method which has been developed by the applicant, involves the use of a tubular trap, preferably having a triangular cross-section and open ends, which may comprise a plastics material, namely an electrically insulating material, and may be provided with a pheromone attractant.

At least part, and preferably a major proportion, of the interior surface of such a tubular trap may be coated with a fine powder which is charged electrostatically, preferably by friction, and is capable of retaining its electrostatic charge for long periods on the interior trap surface which, as indicated above, is preferably of a plastics material and/or electrically insulating. However, the electrostatic charge on the powder discharges more rapidly in high humidity environments and,

irrespective of climatic conditions, wind blowing through the trap tends to remove eventually the powder completely therefrom.

Accordingly, it is a further object of the invention to provide such a pest control trap wherein such removal or other loss of the particulate material, such as a fine powder, from the interior surface of the trap is eliminated or at least substantially reduced.

Thus, a third aspect of the invention resides in a pest control trap comprising a surface having at least one recess therein, wherein a particulate material incorporating a pest killing or behaviour-modifying agent, is accommodated in the or each recess.

Preferably, the or each recess, which is preferably discrete, has dimensions which are generally smaller than those of pests to be controlled. Advantageously, the particulate material is capable of being rendered airborne by movement of a pest in the vicinity thereof. Also, the particulate material, such as a fine powder, may be capable of being charged electrostatically, preferably by friction, as it is rendered airborne, for subsequent contamination of a pest in the vicinity thereof.

A fourth aspect of the invention is directed to a method of preventing the dispersion of a pest-contaminating particulate material from a pest trap, which method comprises accommodating the material, such as a fine powder, in at least one recess in a surface of the trap.

Thus, this inventive method protects the pest-contaminating particulate material from wind action and ensures that it can be attached to a pest, such as a flying insect pest, as it flies above or takes-off from the surface. By using the downthrust of air generated by such a pest's wing beats to render the particulate material, such as a fine powder, airborne, it also ensures at the same time that the powder can become charged electrostatically, so that it will adhere to the pest.

In one embodiment of the invention, there is provided a plate, preferably made of a plastics material, whose surface has an array of recesses associated therewith, preferably in the form of holes, apertures, cavities or other indentations of smaller diameter than the body length of the target pest. This plate may be placed in the bottom of a pest monitoring trap, normally, but not necessarily, in a generally horizontal plane in use. The particulate material, preferably in the form of a fine powder and whether it be charged or uncharged, is accommodated in the recess(es) and, in this manner, is protected from the undesirable effects of wind action or other air currents. Also, the trap need contain no sticky materials or other pest-retaining devices, so that pests can enter and leave the inventive trap readily. In one embodiment, the plate may also constitute the base of the trap.

It is well known that when a flying pest, such as a flying insect pest, is airborne, it gains lift by providing downward momentum to the air around it. It can be calculated that a flying insect pest, such as a mosquito weighing about 1 milligram, can generate a

downward air velocity of 0.5 ms^{-1}, whilst a larger flying inspect pest, such as a large moth weighing about 1 gram, can generate a downward air velocity of 1 ms^{-1}. Additionally, it is known that during take-off, flying insect pests can generate extra lift by generating vortices on the downward strokes of their wings, which vortices are then directed downwardly (Kingsolver, Scientific American 1985).

A flying insect pest which lands on, say, the plate of the embodiment of inventive trap discussed above, and then takes-off or hovers above it, will displace air downwardly at comparatively high velocity. This is sufficient to render the particulate material, such as a fine powder, on the plate, airborne and as the powder becomes detached from the surface of the plate, it can, under certain circumstances, acquire an electrostatic charge. The polarity of any such charge will depend upon the nature of the particulate material and of the surface which is bears it and, thus, can be adjusted so that it is of opposite polarity to that of the surface of the body of the insect pest. In this way, the movement of a flying insect pest can be used to produce an appropriate electrostatic charge on the particles of particulate material, as well as rendering them airborne. The electrostatically-charged particles of particulate material, such as a fine powder, will tend to settle on the insect pest, its being attracted towards it from very short distances.

Thus, it can be seen that the various aspects of the invention provide means for:

1. coating pests, such as insect pests, with a powder whose particles are capable of being rendered airborne by the pests' own movements;

2. reducing loss of powder from a pest control trap or "bait" station by wind or other air currents;

3. controlling powder loss by accommodating the powder or other particulate material in recesses associated with a surface of a pest control trap, such recess(es) being smaller in dimension than the pests;

4. controlling, in particular, flying insect pests by coating them with powder or other fine particulate material which can be charged electrostatically, for example by friction, as it is rendered airborne by the pests' movements;

5. controlling insect pests, in particular, by using powders of other particulate material incorporating biological, synthetic and/or natural pesticides; and

6. controlling crawling pests, for example, insect pests, by using a particulate material which can be rendered airborne by the pests running across a surface bearing the particulate material.

In order that the various aspects of the invention may be more fully understood, preferred embodiments in accordance with at least some of them will now be described by way of example and with reference to the accompanying drawings in which:

Figure 1 is a sectional perspective view of one embodiment of pest control trap;

Figures 2 and 3 are respective plan and sectional views of a base plate of the trap shown in Figure 1; and

Figures 4 and 5 are respective perspective and side elevational views of another embodiment of pest control trap.

Referring firstly to Figures 1 to 3 of the accompanying drawings, an open-ended trap, indicated generally at 1 in Figure 1, for monitoring flying insect pests, is of generally triangular cross-section and comprises a base plate, indicated generally at 2, which has been placed inside the casing 3 of the open-ended trap 1, to replace the conventional sticky surface which is commonly used in such traps.

The base plate 2, as shown in Figures 2 and 3, defines an upper surface 4 thereof and has a central cavity 5 containing an odour attractant (not shown) of suitable formulation, for example, a semiochemical, such as a pheromone or a parapheromone, for attracting flying insect pests into the trap where they can land on and take-off from the upper surface 4 of the plate 2.

Within the surface 4 of the base plate 2 is provided a regular array of circularly cross-sectioned, downwardly-tapering recesses 6 in which is accommodated a particulate material in the form of a fine powder, as shown at 7 in Figure 3, which incorporates a pest-killing or behaviour-modifying agent and which is sufficiently fine for it to be capable of being rendered airborne by the movement of the pests, for example, the wing beats thereof, on,

above or in the region of the powder-bearing surface 4. In this manner, the powder 7 forms a fine cloud thereof above the surface 4, thereby contaminating the insect pests flying above it and any others flying through the trap 1. Preferably, the maximum diameter of the recesses 6, namely, that at the open tops thereof, is less than, say, the body lengths of the pests.

As discussed above, the trap 1, or at least its base plate 2 and associated components, may be made of an electrically insulating material, for example, a suitable plastics material, and the powder 7 may be capable of being charged electrostatically, preferably by friction, as it is rendered airborne by the wing beats or other movements of the flying insect pests in the vicinity thereof. In this way, the electrostatically-charged powder particles adhere to the insect pests, thereby contaminating them and, possibly, allowing them to contaminate other insect pests of the opposite sex during mating attempts.

Various modifications can be incorporated into the pest monitoring trap 1, for example, to reduce loss of the powder 7 by wind action or other air currents blowing through it. Such modifications may include raised edges 9 at the periphery of the plate 2, which edges may be rounded to reduce turbulence being generated over the plate 2. Additionally or alternatively, the recesses 6 may be provided with raised edges 10 around their upper peripheries which may also be used for the same purpose.

The plate 2 may be preformed and arranged to stand alone, for example, by means of the feet 8, as

shown in Figures 2 and 3, or designed to fit into conventional insect traps of various shapes and sizes. Alternatively, the recesses 6 may be formed during the manufacture of the trap 1 in, for example, the base wall of the casing 2.

In the embodiment of pest monitoring trap 1 discussed above with reference to Figures 1 to 3, the base plate 2, and hence the powder-bearing surface 4, lies in a generally horizontal plane during use. However, the orientation of the plane of the base plate 2, and hence that of the powder-bearing surface 4, may be vertical or at any suitable angle thereto.

Such a vertical orientation of the plate and associated powder-bearing surface is shown in the second embodiment of pest monitoring trap, as indicated generally at 11 in Figures 4 and 5. This vertical orientation of the powder-bearing surface 14 of the plate 12 is, in certain circumstances, desirable because some species of flying insect pest, for example, the olive fruit fly, land preferentially on vertical surfaces.

In the second embodiment of flying insect pest monitoring trap shown in Figures 4 and 5, the opposed vertical surfaces 14 of the plate 12 are again provided with recesses, this time in the form of troughs 16, in which is accommodated, once again, a pest-killing or behaviour-modifying powder which is capable, namely, sufficiently fine, of being rendered airborne as a result of the wing beats or other movements of flying insect pests in the region thereof.

The trap 11 is provided with a roof 13 for preventing rainwater from accumulating in the troughs 16, whilst a source 15 of odour attractant, such as that discussed above in relation to the first embodiment of Figures 1 to 3, is provided at the upper region of the plate 12.

Thus, flying insect pests are attracted to the trap 11 by a combination of visual features, including colour, and the odour attractant 15, again as in the case of the first embodiment.

The troughs 16 in which the powder is accommodated, may be placed at an angle to their respective surfaces 14, or, as shown in Figures 4 and 5, may be in the form of cup- or trough-shaped projections, namely, the troughs 16.

The shape of the powder-accommodating recesses 6 of the first embodiment of trap 1 and the corresponding troughs 16 of the second embodiment of trap 11 may also be such that any turbulence of air flowing into them is reduced, which might otherwise lead to vortex formation. For example, they may be V-shaped in vertical section, such as the recesses 6 shown in the first embodiment of trap 1 of Figures 1 to 3. Alternatively, the recesses may also consist of channels in the base plate 2 which can be rectilinear, curved, concentric or spiral. The recesses may be discrete, such as those shown at 6 in the first embodiment of trap 1 or may be substantially continuous, for example, the effectively powder-bearing surface 4 of the plate 2 of the trap 1 may be corrugated.

By suitable modification, the respective recesses 6 and troughs 16 of the first and second embodiments of trap 1,11 may be rendered suitable for crawling insect pests and, indeed, other walking pests, whereby the pests disturb the particulate material, for example, the powder 7 of the first embodiment, by their movement, such as running, across the surface 4,14.

The efficiency of the inventive trap and its powder-bearing surface 4 of the plate 2 was demonstrated in the following experiments.

Two plastics plates 2, each 120 x 180 mm, were placed in a horizontal plane inside respective, separate cages, each 900 x 550 x 600 mm, in the laboratory , each cage containing 50 houseflies (*Musca domestica* L). Each plate 2 had a chemical lure (protein + (Z)-9-tricosene) at its centre, for example, in a central cavity 5.

One plate 2, in accordance with the invention, had ninety six recesses 6, each 6 mm in diameter and 8 mm deep, with generally V-shaped vertical sections, in the surface 4 of the plate 2.

The second plate was of conventional, prior art design, having a smooth surface with no recesses therein and covered with a thin layer of carnauba wax powder weighing 0.32 grams. 0.16 grams of the same material was placed in the recesses 6 of the inventive plate 2.

After twenty four hours, 52% of the flies in the cage containing the first inventive plate 2 were

contaminated with more than fifty particles of the powder, per fly, against only 16% of the flies exposed to the powder-bearing surface of the second prior art plate. By weighing, it was found that the first plate had lost only 37.5% of its powder, whilst the second plate had lost 68.5%.

In a second experiment, the first inventive plate 2 described above was charged with 0.09 grams of carnauba wax powder accommodated in the recesses 6. It was then placed in a horizontal position in the centre of a standard fly testing room, $28m^2$ in area with plain white walls, floor and ceiling with a hundred houseflies and left for five days. At the end of that period, all the flies were coated with powder to the extent of at least 500 powder particles per fly, the amount of powder removed from the plate 2 being approximately 0.01 grams, namely, approximately only 10% of the original amount.

In a third experiment, a concentrated jet of carbon dioxide gas from a pressurised cylinder was directed across the surface of each of the first and second plates for 5 seconds at a velocity of approximately 1 metre per second. Only 18% of the powder was removed from the recesses 6 of the first inventive plate 2, whilst 63% of the powder was removed from the smooth second prior art plate.

In a fourth experiment, the first inventive plate 2 described above was charged with 1.0 grams of carnauba wax powder accommodated in the recesses 6, and then placed horizontally in the bottom of a triangular monitoring trap in place of the normal sticky card. Three traps prepared in this way were

then left suspended from trees outdoors in a garden at Southampton, England for one week, during which time they were exposed to average early summer climatic conditions. Three traps were similarly prepared but with the powder on a flat acetate sheet, to which the powder was initially adhered by electrostatic forces.

At the end of one week, an average of less than 1% by weight of the powder had been lost from the traps with the inventive plate, while an average of approximately 50% had been lost from the traps with the acetate sheet.

Thus, it will be appreciated that the invention enables the coating of pests, such as flying or crawling insect pests, with a pest-killing or behaviour-modifying agent using a vector particulate material capable of being rendered airborne by the pests' own wingbeats or other movements. Also, the loss of the particulate material, such as the powders discussed above, from the inventive pest control trap, by wind or other air currents, is reduced, in some instances, considerably. Further, the loss of particulate material can be controlled by accommodating it in recesses associated with a surface of the inventive pest control trap. Moreover, flying insect pests in particular can be controlled by coating them with powder of other fine particulate material which can be charged electrostatically, for example by friction, as it is rendered airborne by the pests' movements. Such particulate material can incorporate biological, synthetic and/or natural pesticides and may also be rendered airborne by the pests traversing, by walking or running, the surface bearing that material, as described above in

connection with the preferred embodiments.

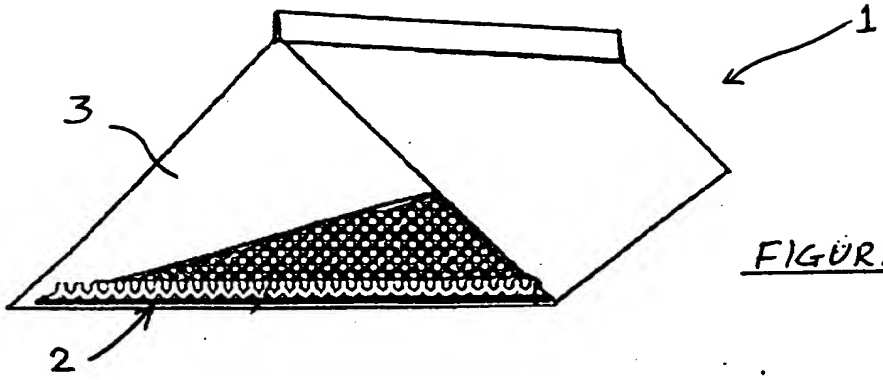

FIGURE 1

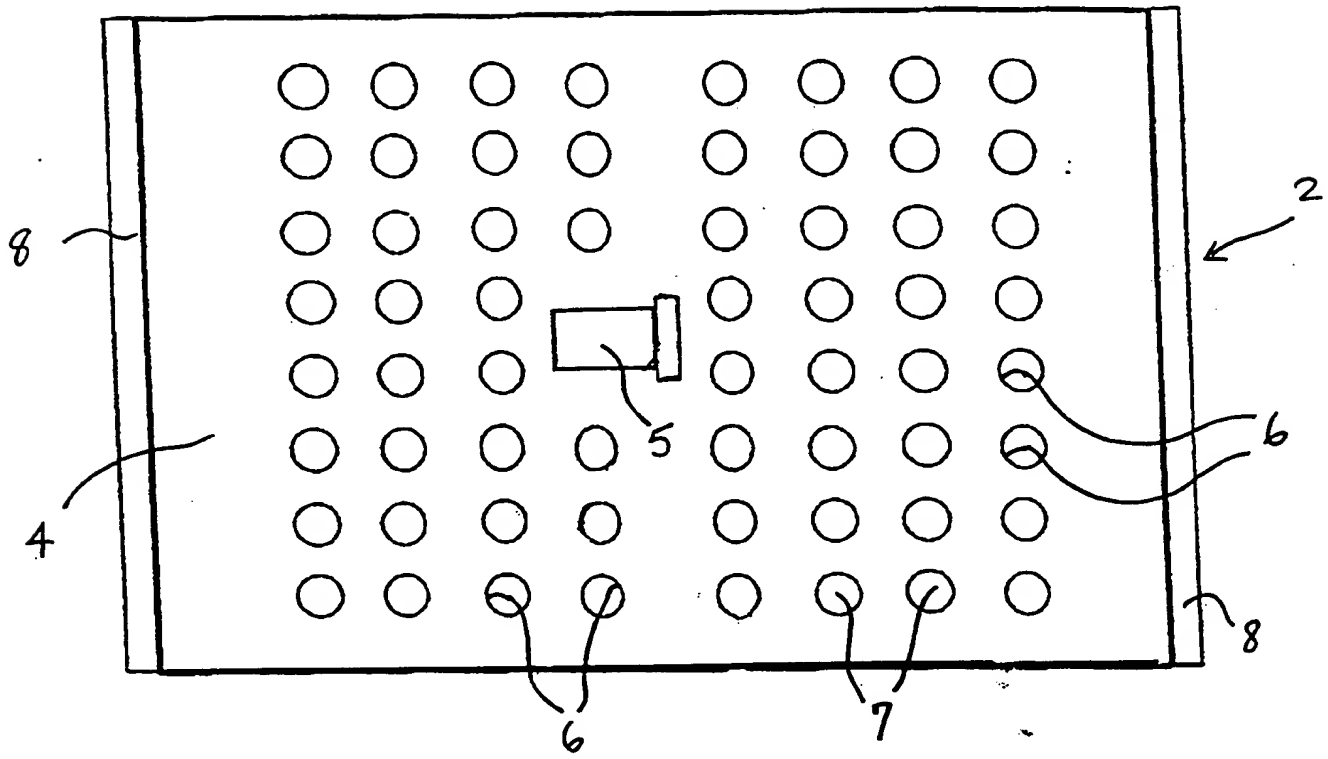

FIGURE 2

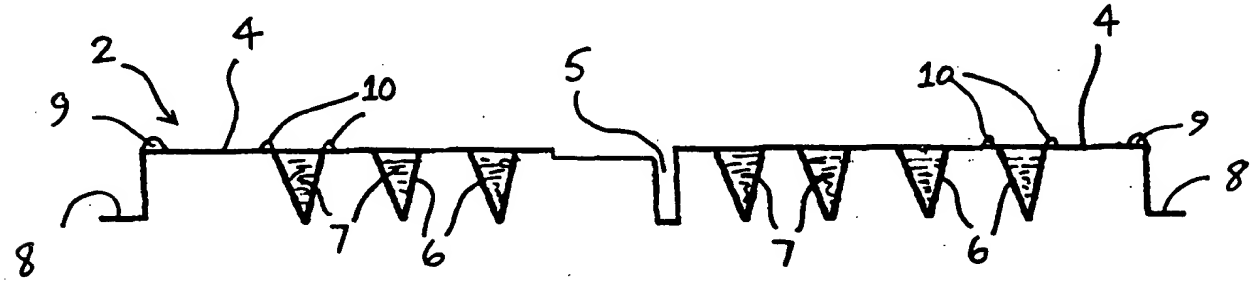

FIGURE 3

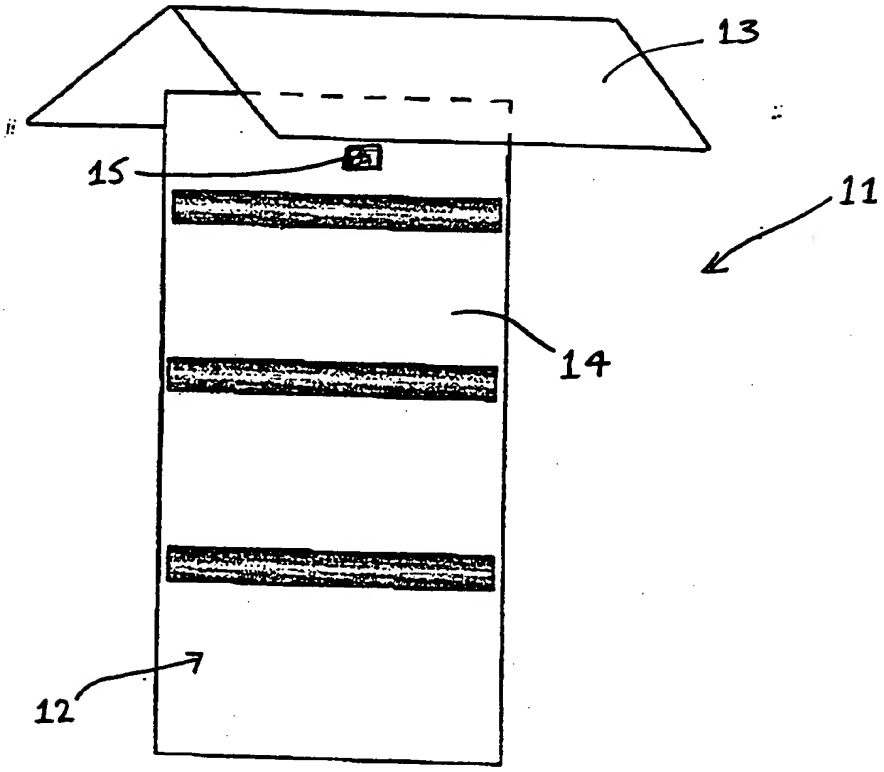

FIGURE 4

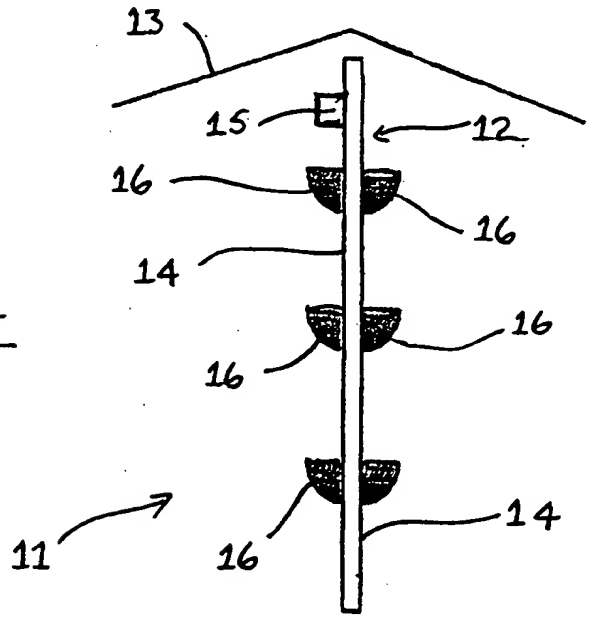

FIGURE 5

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